



Mathematics course outline for first year students

1st semester

Math 203

Course title: Fundamentals of College Mathematics

Course category: compulsory

Course outline

Chapter 1: Logic and set theory (12 hrs)

- 1.1 Definition and examples of proposition
- 1.2 Logical connectives
- 1.3 Compound (or complex) propositions
- 1.4 Tautology and contradiction
- 1.5 Open proposition and quantifiers
- 1.6 The concept of a set and the underlying set operations

Chapter 2: The real and complex number systems (12 hrs)

- 2.1 The real number system
 - 2.1.1 The natural numbers, Principle of mathematical induction and the Well ordering principle
 - 2.1.2 The integers, rational numbers and irrational numbers
 - 2.1.3 Upper bound, lower bound, lub, glb, completeness property of the set of real numbers, and the Archimedean principle
- 2.2 Complex number system
 - 2.2.1 Definition of complex numbers and the underlying operations
 - 2.2.2 Polar representation of complex numbers and the De-Moiver's formula
 - 2.2.3 Extraction of roots

Chapter 3: Functions (12 hrs)

3.1 Review of relations and functions

3.2 Real-valued functions and their properties

3.3 Types of functions (one-to-one, onto) and inverse of a function

3.4 Polynomials, zero's of polynomials, rational functions, and their graphs

3.5 Definitions and basic properties of logarithmic, exponential, hyperbolic, trigonometric functions, and their graphs.

Chapter 4: Analytic geometry (28 hrs)

4.1 Division of segments and various forms of equation of a line

4.2 Conic sections: Equation of a circle, parabola, ellipse and hyperbola

4.3 The general second degree equation

Teaching materials

Textbooks: - Alemayehu Haile and Yismaw Alemu, **Mathematics an introductory course**, Department of mathematics, AAU

- Abera Abay, **An introduction to Analytic Geometry**, AAU, 1998

References: - Raymond A. Barnett, **Precalculus, functions and graphs**, McGraw Hill, 1999

- M. L. Bettinger, **Logic, proof and sets**, Addison-Wesley, 1982

- Dennis G. Zill, Jacqueline M. Dewar, **Algebra and trigonometry**, 2nd Edition.

- Kinfe Abraha, **Basic Mathematics**, Mekelle University, Mega Printing Press, 2002. Mekelle, Ethiopia

Math 321

Course title: **Fundamental Concepts of Algebra**

Course code: Math 321

Prerequisite: Math 203

Course category: Compulsory

Course outline

Chapter 1: Mathematical logic (9 hrs)

1.1 Review of equivalent propositions, tautology and contradictions, predicate Logic, open proposition and qualified propositions

1.2 Argument and validity of statements

1.3 Mathematical proofs

Chapter 2: Set theory (12 hrs)

2.1 Review of sets and set operations, ordered pairs, relations and functions

2.2 Order and equivalence relation

2.3 Classification of sets

2.4 Cardinal numbers

Chapter 3: Groups (12 hrs)

3.1 Binary operations, algebraic structures

3.2 Identity element and inverses

3.3 Morphisms

3.4 Definition and examples of groups

3.5 Subgroups, cosets, and Lagrange's theorem

3.6 Normal subgroups and quotient groups

3.7 Homomorphisms

Chapter 4: Rings (9 hrs)

4.1 Definition of rings and examples

4.2 Subrings and characteristic of a ring

4.3 Ideals and quotient rings

4.4 Homomorphism of rings

4.5 Integral domains and the field of quotients

4.6 Polynomial rings

4.7 Prime fields

Chapter 5: The system of integers (6 hrs)

5.1 Properties of addition and multiplication 5.2 Order axioms of the system of integers

5.3 Well-ordering axioms

5.4 Mathematical induction

5.5 Characterization of the system of integers

Teaching materials

Textbook: - Demissu Gemedu and Seid Mohammed, **Fundamental**

Concepts of Algebra, Dept. of Mathematics, AAU, 2008

References:

- B. Fraleigh John, **A First Course in Abstract Algebra**, 2nd ed,

Addison-Wesley publishing Company, Reading

- J. J. Gerald, **Introduction to modern algebra(revised)**,

4th ed; University Book Stall, Reading, 1989

- D. S. Dummit and R. M. Foote, **Abstract algebra**, 3rd ed, John

Wiley and Sons, 2004.

- P. B. Bhattacharya *et-al*, **Basic abstract algebra**, 2nd ed, Cambridge University press, 1995

- N. H. McCoy *et-al*, **Introduction to abstract algebra**, Academic Press, 2005

2nd semester

Math 264

Course title: Calculus I

Course code: Math 264

Credit hours: 4 **Contact hrs:** 4 **Tutorial hrs:** 2

Prerequisite: None

Course category: compulsory

Course outline

Chapter 1: Limits and continuity (12 hrs)

- 1.1. $\varepsilon - \delta$ Definition of limit
- 1.2 Basic limit theorems
- 1.3 One-sided limits
- 1.4 Infinite limits and limits at infinity
- 1.5. Continuity
- 1.6. The Intermediate Value Theorem and its applications

Chapter 2. Derivatives (14 hrs)

- 2.1 Definition of derivative
- 2.2 Tangent and normal lines
- 2.3 Properties of derivatives
- 2.4 Derivative of functions (polynomial, rational, trigonometric, exponential, logarithmic and hyperbolic functions)
- 2.5 The chain rule
- 2.6 Higher order derivatives
- 2.7 Implicit differentiation

Chapter 3. Applications of derivatives (20 hrs)

- 3.1 Extreme values of functions
- 3.2 Rolle's Theorem, the Mean Value Theorem, and their applications
- 3.3 Monotonic functions

- 3.4 The first and second derivative tests
- 3.5 Applications to extreme values and related rates
- 3.6 Concavity & inflection points
- 3.7 Graph sketching
- 3.8 Tangent line approximation and the differentials

Chapter 4. Integrals (18 hrs)

- 4.1 Antiderivatives
- 4.2 Indefinite integrals and their properties
- 4.3 Partitions, upper and lower sum, Riemann sums
- 4.4 Definition and properties of definite integral
- 4.5 The Fundamental Theorem of Calculus
- 4.6 Techniques of integration (integration by parts, integration by substitution, integration by partial fractions)
- 4.7 Application of integration: Area, volume of solid of revolution

Textbook: - Robert Ellis and Denny Gulick, **Calculus with analytic geometry**, 6th ed, Harcourt Brace Jovanovich, Publishers, 5th ed, 1993.

References:

- Leithold, **The calculus with analytic geometry**, 3rd Edition, Herper & Row, publishers.
- R. T. Smith and R. B. Minton, **Calculus concepts and connections**, McGraw-Hill book company, 2006
- D. V. Widder, **Advanced calculus**, Prentice-Hall, 1979
- Ross L. Finney et al, **Calculus**, Addison Wesley, 1995
- E. J. Purcell and D. Varberg, **Calculus with analytic geometry**, Prentice-Hall INC., 1987
- Adams, **Calculus: A complete course**, 5th ed, Addison Wesley, 2003
- R. Wrede and M. R. Spiegel, **Theory of advanced calculus**, 2nd ed., McGraw-Hill, 2002.
- A. E. Taylor and W. R. Mann, **Advanced calculus**, 3rd ed, John-Wiley and Son, INC, 1995.

Math 365

Course title: Calculus II

Course code: Math 365

Course category: Compulsory

Course outline

Chapter 1. Inverse functions (12 hrs)

- 1.1 Properties of inverse functions
- 1.2 Derivative of inverse functions
- 1.3 Inverses of trigonometric functions and their derivatives
- 1.4 Exponential and logarithmic functions
- 1.5 Exponential growth and decay
- 1.6 Inverse of hyperbolic functions and their derivatives

Chapter 2. Techniques of integration (12 hrs)

- 2.1 Elementary integration formulas
- 2.2 Integration by parts
- 2.3 Integration by trigonometric substitution
- 2.4 Integration by partial fractions
- 2.5 Trigonometric integrals
- 2.6 Trapezoidal and Simpson's rule
- 2.7 Application of integration (area, volume, arc length, surface area)

Chapter 3 Indeterminate forms, improper integrals and Taylor's formula (12 hrs)

- 3.1 Cauchy's formula
- 3.2 Indeterminate forms (L' Hopital's Rule)
- 3.3 Improper integrals
- 3.4 Taylor's formula
- 3.5 Approximation by Taylor's polynomial

Chapter 4. Sequence and series (30 hrs)

- 4.1 Sequences
 - 4.1.1 Convergence and divergence of sequences

4.1.2 Properties of convergent sequences

4.1.3 Bounded and monotonic sequences

4.2 Infinite series

4.2.1 Definition of infinite series

4.2.2 Convergence and divergence of series

4.2.3 Properties of convergent series

4.2.4 Convergence tests for positive term series (integral, comparison, ratio and root tests)

4.2.5 Alternating series

4.2.6 Absolute convergence, conditional convergence

4.2.7 Generalized convergence tests

4.3 Power series

4.3.1 Definition of power series

4.3.2 Convergence and divergence, radius and interval of convergence

4.3.3 Algebraic operations on convergent power series

4.3.4. Differentiation and integration of a power series

4.3.5 Taylor & Maclaurin series

4.3.6 Binomial Theorem

Teaching materials

Textbook: - Robert Ellis and Denny Gulick, **Calculus with analytic geometry**, 5th ed, 1993

References:

- Leithold, **The calculus with analytic geometry**, 3rd Edition, Herper & Row, publishers.

- R. T. Smith and R. B. Minton, **Calculus concepts and connections**, McGraw-Hill book company, 2006

- D. V. Widder, **Advanced calculus**, Prentice-Hall, 1979

- Ross L. Finney et al, **Calculus**, Addison Wesley, 1995

- E. J. Purcell and D. Varberg, **Calculus with analytic geometry**, Prentice-Hall INC., 1987

- Adams, **Calculus: A complete course**, 5th ed, Addison Wesley, 2003

- R. Wrede and M. R. Spiegel, **Theory of advanced calculus**, 2nd ed., McGraw-Hill, 2002.

- A. E. Taylor and W. R. Mann, **Advanced calculus**, 3rd ed, John-Wiley and Son, INC, 1995.